VERIFICATION OF TRANSLATION

I, Toyoaki Fukui, FUKUI & PARTNERS, of 1-19, Uchihonmachi 2-chome, Chuo-ku, Osaka-shi, Osaka, Japan, do hereby solemnly and sincerely declare:

that I have a competent knowledge of the English and Japanese Languages,

that the attached document is a true and correct translation made by me to the best of knowledge and belief of: Japanese Patent Application No. 2002-315653 filed on October 30, 2002 with Japan Patent Office.

Dated This 7th day of December 2006.

T. Fukui

Toyoaki Fukui
Translator

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[Expression of Fee]

[Deposit Account No.] 009483

[Amount of payment] 21,000 yen

[List of Attached Articles]

[Document Name] Specification 1

[Document Name] Drawings 1

[Document Name] Abstract 1

[Number of General Power of Attorney] 9713946

[Proof request] Yes

[Document Name] Description

[Title of the Invention] Light source for image writing apparatus

[Claims]

[Claim 1] A light source of image writing apparatus including a light emitting element, and a light transmitting means forming an image on a photosensitive drum by light emitted from the light emitting element, the light source comprising:

a converting means for converting an advancing direction of the light; and

the light transmitting means for forming the image on the photosensitive drum by the light of which advancing direction is converted by the converting means.

[Claim 2] The light source of image writing apparatus according to claim 1, wherein the light emitting element is layered on a surface of a substrate so as to emit the light in a direction perpendicular to the surface; and

the converting means is formed on the light emitting element.

[Claim 3] The image writing apparatus according to claim 1, wherein the converting means is formed on a surface of a substrate; and

the light emitting means is formed on the converting means so as to emit the light toward the converting means.

[Claim 4] The light source of image writing apparatus according to claim 1, wherein the light emitting element is formed on a surface of a substrate so as to emit the light in a direction perpendicular to the surface; and

the converting means is formed on another surface of the substrate.

[Claim 5] The light source of image writing apparatus according to claim 1, wherein the converting means is a prism for reflecting the light source toward a specific direction.

[Claim 6] The light source of image writing apparatus according to claim 1, wherein the converting means is a light guide to lead the light to a specific direction.

[Claim 7] The light source of image writing apparatus according to claim 4 or 6, wherein the specific direction is parallel to the substrate.

[Claim 8] The light source of image writing apparatus according to claim 1, wherein the converting means converts the advancing direction of the light to a normal direction against the photosensitive drum.

[Claim 9] The light source of image writing apparatus according to claim 1, wherein the image writing apparatus is provided with a plurality of photosensitive drums arranged in series.

[Claim 10] The light source of the image writing apparatus according to claim 1, wherein the light emitting element consists of an organic electro luminescence.

[Detailed Description of the Invention]

[0001] [Technical Field]

The present invention relates to a light source for an image writing apparatus.

[0002] [Background Art]

Some color laser printers (which is called a printer hereinafter) 100 employ the printing method called the tandem method that enables the printer to print in parallel a visible image consisting of four colors, Y (yellow), M (magenta), C (cyan) and B (black), as shown in Fig. 13, so that the printer can perform the high-speed printing. In order to form the four-colored visible image in parallel, the printer 100 employing the tandem method is provided with 4 sets of writing systems 110, each system including an electric discharger 105, a photosensitive drum 106, an electric charger 107, a light source 200, and a developing device 108, as shown in Fig. 14.

[0003] A recording paper 120 on a tray 101 in Fig. 12 is fed to a traveling route 103 inside the printer 100 by a carrying roller 102. While the carrying roller 120 is carrying the recording paper 120, the writing light emitted from the light source 200 forms a latent image on each photosensitive drum 106 per color, and then the developing device 108 forms a visible image.

[0004] The visible image formed on each photosensitive drum 106 is transcribed on the recording paper 120 on the traveling route 103, and then a fixing device 109 fixes the visible image thereon. After that, the recording paper 120 is outputted from the printer 100.

[0005] The light source 200 is provided with a substrate 601 extended to the main scanning direction on which light emitting elements 8 consist of a number of LEDs (Light emitting Diode) are formed, as shown in Fig. 15. The light emitting element 8 emits a ray of light A in the direction perpendicular to the substrate 601. As shown in Fig. 15, the ray A passes through the light transmitting means 310 such as the rod lens or the fiber lens, and forms the latent image on the photosensitive drum 106.

[0006] In order to emit light A toward the photosensitive drum 106, the substrate 601 is configured as shown in a short side of substrate 601 is parallel with the sub scanning direction (the direction perpendicular to the axis of the photosensitive drum 106) and a surface of the substrate 601 on which the light emitting elements 8 are formed faces the photosensitive drum 106.

[0007] [Cited document 1] JP58-46361A

[Cited document 2] JP58-58566A

[0008] [Problem to be solved by the Invention]

It is said that the light emitting element 8 must be in a specific size in order that the light source 200 outputs the luminous intensity enough to form a latent. And the substrate 601 must be provided with accessories such as a driver to emit light from the light emitting element 8. Therefore, the short side of the substrate 601 should be a predetermined length.

[0009] Under the above-mentioned configuration, that is, when the short side of the substrate 601 is parallel with the sub scanning direction and the surface provided with the light emitting elements 8 faces the photosensitive drum 106, if the short side of the substrate is long, the sub scanning direction of the writing system 110 per color becomes long.

[0010] In the tandem type of the printer 100, 4 colors writing systems 110 are disposed in series in the sub scanning direction. Even if the length of the writing system 110 becomes a little long in the sub scanning direction, slightly, the printer 100 becomes big.

[0011] The present invention has an object to provide with a light source of which sub-scanning direction is short, in order to downsize the printer, wherein each space between the writing systems is short.

[0012] [Means for solving problem]

The present invention suggests a light source for image writing apparatus that can radiate light to a normal direction to a photosensitive drum regardless of the direction in which a substrate is disposed, by converting an advancing direction of the light emitted from a light emitting element.

[0013] The light source of image writing apparatus of the invention is provided with a converting means for converting the advancing direction of light, in order to convert the advancing direction of the light. The converting means may be a prism, or a light guide for converting the advancing direction of light by reflecting the light therein plural times.

[0014] In a conventional configuration, which is not provided with the converting means, the short side of the substrate should be parallel with the sub-scanning direction, and the light emitting surface should face the photosensitive drum, in order that the light irradiates the photosensitive drum. But the light source of the invention, which is provided with the converting means, can eliminate the necessity of such configuration. In other words, the light source of the invention is configured that, when the height of the substrate (the length from the light emitting surface to the upper end of the sealing glass) is less than the short side of the substrate, the height direction of the substrate is parallel with the subs-canning direction, and a surface formed by the longitudinal

direction and height direction of the substrate faces the photosensitive drum.

[0015] [Models for carrying out the invention]

(Embodiment 1)

A light source 200 for image writing apparatus in the invention (which is called a 'light source 200') is applied as a light source to the color laser printer (which is called a printer hereinafter) 100 shown in Fig. 13, like the conventional way.

[0016] The light source 200 in this embodiment is composed of a transparent substrate 301 and a light transmitting means 310 that are extended to the main scanning direction as shown in Fig.1. On one surface of the transparent substrate 301, a row of a plurality of light emitting elements 8 is formed by means of a following method.

[0017] First, a transparent electrode layer 2 like ITO (Indium Tin Oxide) is applied on the whole surface of the transparent substrate 301, as shown in Fig. 2(A). And a shading film 3 masks a section of the transparent electrode layer 2, the section on which a transparent electrode element 1 is formed as an anode. The formed transparent electrode layer 2 is subjected to the photolithography, such as the exposure, the development, and the etching. After the photolithography, the other sections without the masking are removed from the transparent substrate 301, as shown in Fig. 2(B). And each masked section becomes the transparent electrode element 1.

[0018] In the next step, an organic EL (Electro Luminescence) is applied on the whole surface of the transparent substrate 301, the surface on which the transparent electrode elements 1 are formed, as shown in Fig. 2(C), which forms an organic EL layer 4. On the surface of the organic EL layer 4, the metal to be a metal electrode layer 5 is applied as the common electrode. The organic EL layer 4, which is sandwiched between the metal electrode layer 5 and the transparent electrode element 1, becomes a light emitting element 8.

[0019] Besides, in order to protect the organic EL layer 4 from a physical impact or the moisture, the organic EL layer 4 is subjected to the sealing. As shown in Fig. 2(D), the sealing is the processing that an adhesive resin 6 like epoxy resins including the glass filler is applied on a sealing section 304 and the metal electrode layer 5 and the resin 6 are sealed by the sealing glass 7. The light emitting element 8 thus formed emits a ray of light A in the direction perpendicular to the transparent substrate 301, and the ray A passes through the transparent electrode element 1 and is discharged from the transparent substrate 301, as shown in Fig. 2(D).

[0020] The transparent substrate 301 is disposed so that the surface G formed by the long side

direction L and the height direction H of the transparent substrate 301 faces a photosensitive drum 106, as shown in Fig. 1.

[0021] And a prism 401 extended to the main scanning direction is disposed on a surface (which is called a light emitting surface 301a hereinafter) opposite to the surface on which the light emitting elements are formed, and the disposed position corresponds to the row of the light emitting elements.

[0022] The ray A emitted from the light emitting element 8 passes through both the transparent electrode element 1 and the transparent substrate 301, and goes into the light emitting surface 301a. Specifically, the ray A is discharged from the transparent substrate 301 and comes into the prism 401.

[0023] The prism 4 uses a right-angle prism, wherein the ray incident from one surface making a right angle of the right-angle prism turns the direction by 90 degree on a slanting surface 401a and is discharged from another surface making the right angle of the right-angle prism. Accordingly, the advancing direction of the ray A converts the direction parallel to the transparent substrate 301 (the normal direction of the photosensitive drum 106).

[0024] The light transmitting means 310 is disposed between the prism 401 and the photosensitive drum 106, so as to form a latent image on the photo sensitive drum 106 by the ray A emitted from the prism 401.

[0025] The light transmitting means 300 consists of a lens alley binding a plurality of optical lens like a fiber lens 303, a rod lens, or a micro lens. Besides, the optical system used to the light transmitting means may be an image transmitting type or a type of transmission for the light intensity. In this embodiment, the light remitting means 300 uses a fiber lens array of biding plural fiber lenses 303 shown in Fig. 3(A) to Fig. 3(C).

[0026] As shown in Fig. 3A and 3B, the fiber lens alley is formed by disposing a plurality of the fiber lenses 313, of which each axis faces to the normal direction of the photosensitive drum 106, in each space surrounded by two base frames 311 and a light absorbing layer 312, and the gaps between the fiber lenses are filled with opaque resins. The light absorbing layer 312 is provided in order to prevent the crosstalk between the fiber lenses 313, but it is possible to obtain the same effect by applying the opaque resins to be the light absorbing layer 312 on the circumference of each fiber lens 313. In addition, the crosstalk can be prevented by using both the light absorbing layer 312 provided between the base frames 311 and the light absorbing layer 312 applied on the circumference of the fiber lens 312.

[0027] The ray A of which advancing direction is converted by the prism 401 passes through the light transmitting means 310 and illuminates the photosensitive drum 106, with the result that the latent image is formed.

[0028] As described above, the light source 200 is provided with the prism 401 as a converting means for changing the advancing direction of the ray A, and thereby the ray A emitted from the light emitting element 8 can illuminate the photosensitive drum 106 without facing the light emitting surface 301a of the transparent substrate 301 to the photosensitive drum like the conventional way.

[0029] Fig. 4A shows a sectional view of the writing system 110, wherein a height h between the light emitting surface 301a and the top of the sealing glass 7a (which is called the "height") is shorter than a shorter side s of the transparent substrate 301, and the shorter side s of the transparent substrate 301 is disposed so as to be parallel with the sub-scanning direction while the light emitting surface 301a of the transparent substrate 301 is disposed so as to face to the photosensitive drum 106 in the same as conventional way. And Fig. 4(B) shows a sectional view of the writing system 110, wherein the surface G formed by both the long side direction L and the height direction H of the transparent substrate 301 is disposed so as to face to the photosensitive drum 106 like Fig. 1. As shown in Fig. 4(B), the sub scanning direction of the light source 200 gets shorter by disposing the surface G so as to face the photosensitive drum 106. Accordingly, it is possible to carry out the writing system 110 with the shorter sub scanning direction.

[0030] If the sub scanning direction of the light source 200 gets shorter, the writing system 110 shown in Fig. 13 has the short sub scanning direction. Thereby the pitch of each photosensitive drum becomes narrow, so that the printer 100 can be downsized.

[0031] In addition, the prism 401 as the converting means in the above description converts the advancing direction of the ray A in 90 degree as shown in Fig. 1, but the degree to convert the advancing direction is changeable freely by adjusting the degree of the slanting surface 401a.

[0032] Therefore, the layout of the assemblies inside the printer 100 can be designed according to the downsizing of the printer and the facilities of the printer production rather than the advancing direction of the ray A.

[0033] Besides, the above embodiment is explained based on that the prism 401 is used to the converting means. But the converting means may be a unit to convert the advancing direction of the ray A emitted from the light emitting element 8, and the shape or material of the converting means is not limited in particular.

(Embodiment 2)

The converting means except for the prism 401 may be a light guide 402 as shown in Fig. 5, and the light guide 402 is made of a transparent material with higher refractive index than the air and the transparent substrate 301. As shown in Fig. 5(A), a reflection material 404 made of a material without the transparency such as a metal is layered over a surface 407 opposite to an emitting surface 408 from which the ray A incident to the light guide 402 is emitted.

[0034] Each light guide 402 is disposed on the light emitting surface 301a so as to contact an upper surface 405 with an opposite position to the transparent electrode element 1, as shown in Fig. 6.

[0035] As described in Embodiment 1, the light emitting element 8 emits the ray A downward as shown in Fig. 6. Accordingly, the ray of light emitted from the light emitting element 8 passes through the transparent electrode element 1 and the transparent substrate 301, and comes into the light guide 402 through the upper surface 405 of the light guide 402.

[0036] As described above, the reflection material 404 is layered over the surface 407, and the refractive index of the light guide 402 is higher than the air and the transparent substrate 301. Therefore, the ray A incident into the light guide 402 through the upper surface 405 repeats the total reflection in the light guide 402, and then is emitted from the emitting surface 408.

[0037] In result, the advancing direction of the ray A converts from the downward direction shown in Fig. 6 to the left side direction by passing through the light guide 402, that is to say, the direction is converted with 90 degree.

[0038] Besides, the ray A emitted from the emitting surface 408 of the light guide 402 passes through the light transmitting means 310 and illuminates the photosensitive drum 106, whereby the latent image is formed.

[0039] In addition, the above explanation refers to the case that the advancing direction of the ray of light is converted with 90 degree by using the light guide 402 as shown in Fig. 6. However, the advancing direction of the ray A is changeable freely by adjusting the longitudinal direction of the light guide 402 to any direction of the ray A to be emitted, as shown in Fig. 7.

[0040] Moreover, in such case that the above-mentioned light guide is used as the converting means, the section area of light emitted from the light emitting surface 408 has the same size as the light emitting surface 408 regardless of the size of luminous area of the light emitting element 8. Accordingly, forming the light emitting element 8 with a large light emitting surface on the transparent substrate 301 can increase the luminous flux density of the light emitted from the

emitting surface 408.

[0041] Therefore, the light source 200 has a short sub scanning direction and outputs the light with higher luminous flux density by means of the light guide 402 as the converting means. Besides, the shape of the light guide 402 is not need to be a rectangular parallelepiped shown in Fig. 5(A), but may be a pentagon prism or a hexagon prism shown in Fig. 5(B) or Fig. 5(C).

[0042] (Embodiment 3)

Embodiments 1 and 2 explains about the configuration that the prism 401 or the light guide 402 is disposed on the light emitting surface 301a of the transparent substrate 301. Additionally, the prism 401 or the light guide 402 may be disposed on the same surface that the light emitting surface 8 is formed, as shown in Fig 8 to Fig. 10.

[0043] That is to say, the prism 401 is disposed on the sealing glass 7 so as to emit the ray A emitted from the light emitting element 8 in the opposite direction to that described in Embodiments 1 and 2, and to lead the ray A into the prism 401 though the sealing glass 7.

[0044] However, when the light emitting element 8 is formed as described in Embodiment 1, an opaque metal electrode layer 5 is formed on the upper side of the light emitting element 8 and the ray A cannot be emitted to the sealing glass 7. The cathode must use the material with lower work function than the transparent electrode element 1 to be the anode in order to improve the luminous efficiency of the organic EL, whereby the opaque metal electrode layer 5 is applied to the cathode.

[0045] The thickness of the metal electrode layer 5 should be a specific value (approximate 100Å) permeable to the light so as to emit the ray A from the side of the sealing glass 7, as shown in Fig. 8. And in order that the electric current flows uniformly over the thin metal electrode layer 5, an electrode layer 5a made of a transparent material should be formed on the metal electrode layer 5.

[0046] According to such configuration, the ray A can be emitted to the upward direction in Fig. 8, and simultaneously, also be emitted to the downward direction. To prevent the downward emission, a reflection plate 309 should be provided between the transparent substrate 301 and the transparent electrode element 1.

[0047] Additionally, like Embodiment 1, the organic EL layer 4, the metal electrode layer 5 and the electrode layer 5a should be covered by the resin 6 and the sealing glass 7 in order to protect the organic EL layer 4 from the physical impact and the moisture.

[0048] By reducing the thickness of the metal electrode layer 5, the ray A emitted from the light

emitting element 8 is emitted from the sealing glass 7, and incident into the prism 401 provided on the sealing glass 7.

[0049] After the ray A incident into the prism 401 changes the advancing direction by being reflected on the slanting surface 401a, the ray A is emitted from the prism 401, like Embodiment 1.

[0050] As described above, when the prism 401 and the light emitting element 8 are provided on the same surface of the transparent substrate, the light transmitting means is also provided on the same surface on which the light emitting element 8 is formed. Accordingly, the ray emitted from the prism 401 radiates the photosensitive drum through the light transmitting means 310, and then the latent image is formed thereon.

[0051] When the prism 401 and the light transmitting means 310 are disposed on the same surface on which the light emitting element 8 is formed in such way, the transparent substrate 301 is not provided with anything on the surface opposite to the surface on which the light emitting surface element 8 is formed. This makes it easy to handle the light source 200.

[0052] Besides, instead of disposing the prism 401 on the sealing glass 7 as above, the prism 401 or the light guide 402 may be disposed on the electrode layer 5a and the resin 6 as shown in Fig. 9 and Fig. 10. In such case, the prism 401 or the light guide 402 involves the function as the sealing glass 7.

[0053] (Embodiment 4)

The prism 401 or the light guide 402 may be disposed between the transparent substrate 301 and the light emitting element 8.

[0054] When the prism 401 is disposed on the transparent substrate 301, a support stand 502 to support the prism 401 is formed on the transparent substrate 301 by applying the material with the lower refractive index than the prism 401 or of the opaque material on the transparent substrate 301, as shown in Fig. 11. And the prism 401 is placed on the support stand 502 so that the slanting surface 401a of the prism may be contacted with the slanting side of the support stand 502.

[0055] By means of the same way in Embodiment 1 to form the light emitting element 8 on the transparent substrate 301, the light emitting element 8 is formed on the prism 401. And the light transmitting means 310 is disposed on the same surface of the transparent substrate 301 that the prism 401 is disposed.

[0056] As shown in Fig. 11, after the ray A emitted from the light emitting element 8 comes into the prism 401 through the transparent electrode element 1, the ray A changes the advancing direction by reflecting the ray A on the slanting surface 401a. The reflected ray A forms the latent

image on the photosensitive drum 106 through the light transmitting means 310.

[0057] And as shown in Fig. 12, the light guide 402 instead of the prism 401 may be disposed between the transparent substrate 301 and the light emitting element 8 so that a lower surface 403 of the light guide 402 may face to the transparent substrate 301.

[0058] The light guide 402 is provided with the light emitting element 8 thereon in the same way of forming the prism 401 thereon. The ray A emitted from the light emitting element 8 is emitted from the emitting surface 408 after repeating the total reflection within the light guide 402 like Embodiment 2. The emitted ray A forms the latent image on the photosensitive drum 106 through the light transmitting means 310.

[0059] The above descriptions were discussed in case of using the light source 200 of the image writing apparatus of the present invention to the tandem type color laser printer 100, however, the light source 200 of the image wiring apparatus of the present invention may be used as a light source for the color laser printer without adopting the tandem method or for a laser printer to perform monochrome printing.

[0060] [Effect of the Invention]

The advancing direction of the ray emitted from the light emitting element is changeable freely by the converting means, so that the direction to dispose the light source can be decided regardless of the emitted light direction of the light emitting element. Therefore, it is possible to reduce the size of the printer by disposing the light source in the direction so that the sub scanning direction becomes short.

[Brief description of drawings]

[Fig. 1] is a sectional view of the light source using the prism as the converting means and the photosensitive drum.

[Fig. 2] shows a production process of the light emitting element.

[Fig. 3] is an external view of the light transmitting means.

[Fig. 4] is an outline view of the light source and the photosensitive drum of the image writing apparatus.

[Fig. 5] is a diagram showing a shape of the light guide.

[Fig. 6] is a sectional view of the light source using a light guide as the converting means and the photosensitive drum.

[Fig. 7] is a sectional view of the light source using a light guide as the converting means.

[Fig. 8] is a sectional view of the light source using a prism as the converting means.

[Fig. 9] is a sectional view of the light source using a prism as the converting means.

[Fig. 10] is a sectional view of the light source using a light guide as the converting means and the photosensitive drum.

[Fig. 11] is a sectional view of the light source using a prism as the converting means.

[Fig. 12] is a sectional view of the light source using a light guide as converting means.

[Fig. 13] is an outline view of a printer.

[Fig. 14] is an enlarged view of the light source.

[Explanation of the letters or numerals]

8	light emitting element
100	printer
106	photosensitive drum
301	transparent substrate
310	light transmitting means
401	prism
402	light guide

[Name of document] Abstract

[Summary]

[Problem to be solved] In order to reduce the printer size, the writing system for each color needs to make the sub scanning direction short, however, it is not possible to make the sub scanning direction of the light source short due to the structure of the light source of the writing system.

[Solution] The light source is provided with the converting means for converting the advancing direction of the light emitted from the light source. Therefore, the direction to dispose the light source can be decided regardless the direction of the emitted light.

[Selected drawing] Fig. 1

FIG. 1

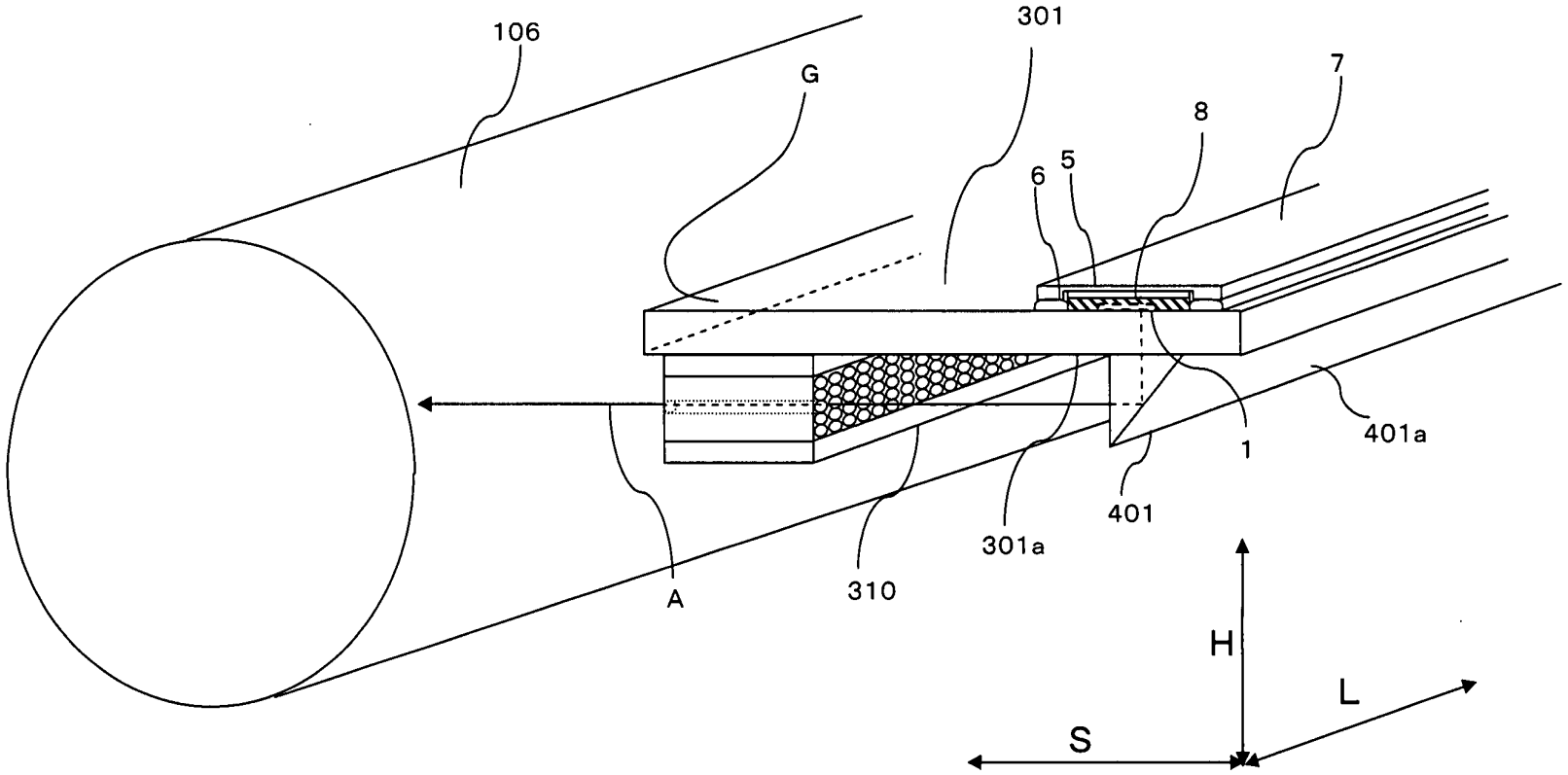


FIG. 2

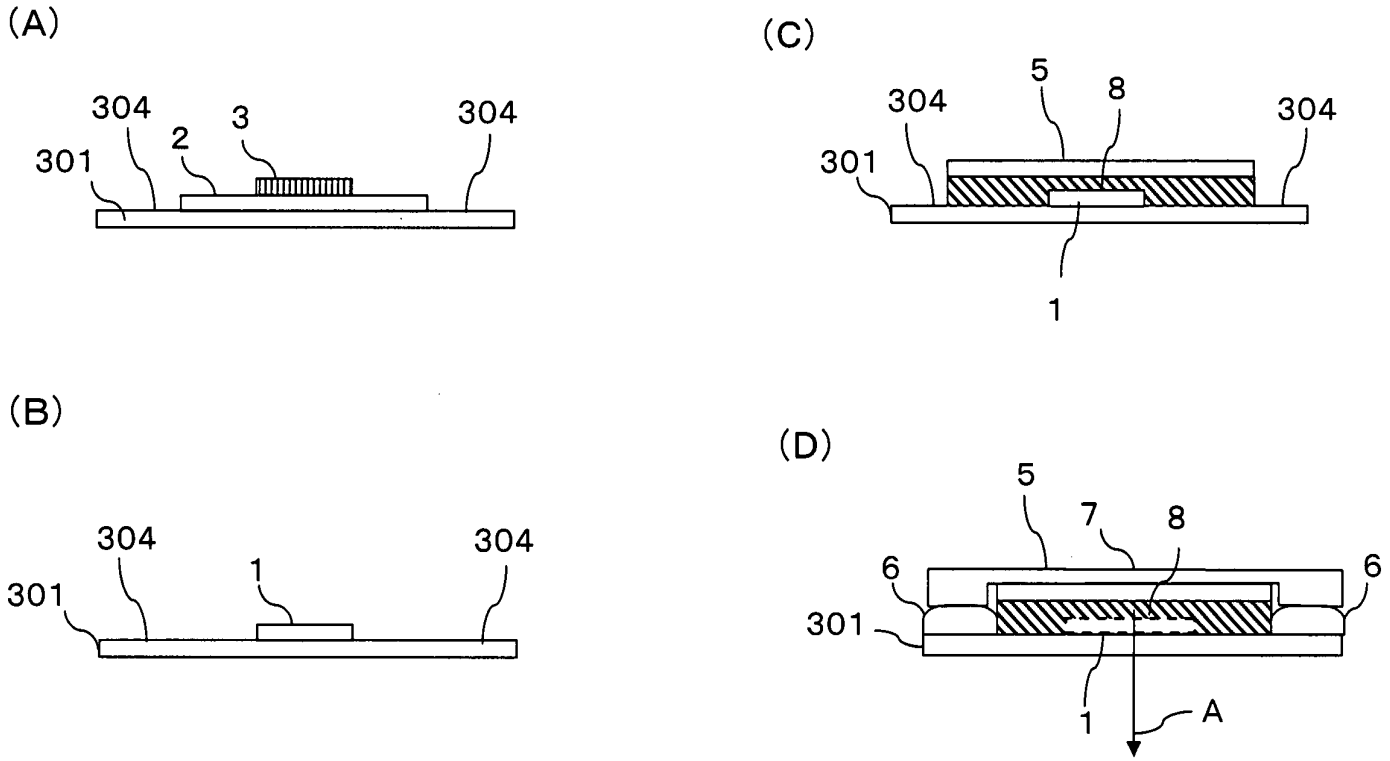


FIG. 3

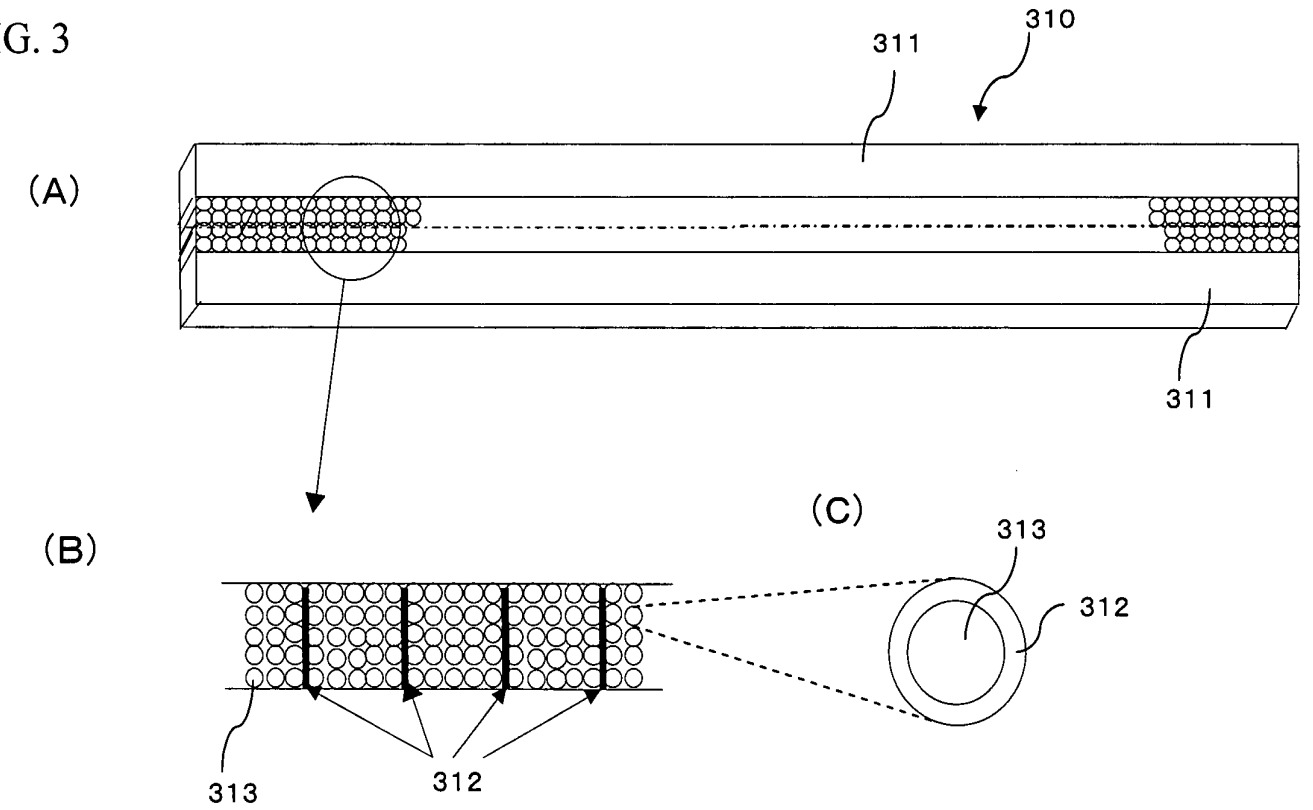


FIG. 4

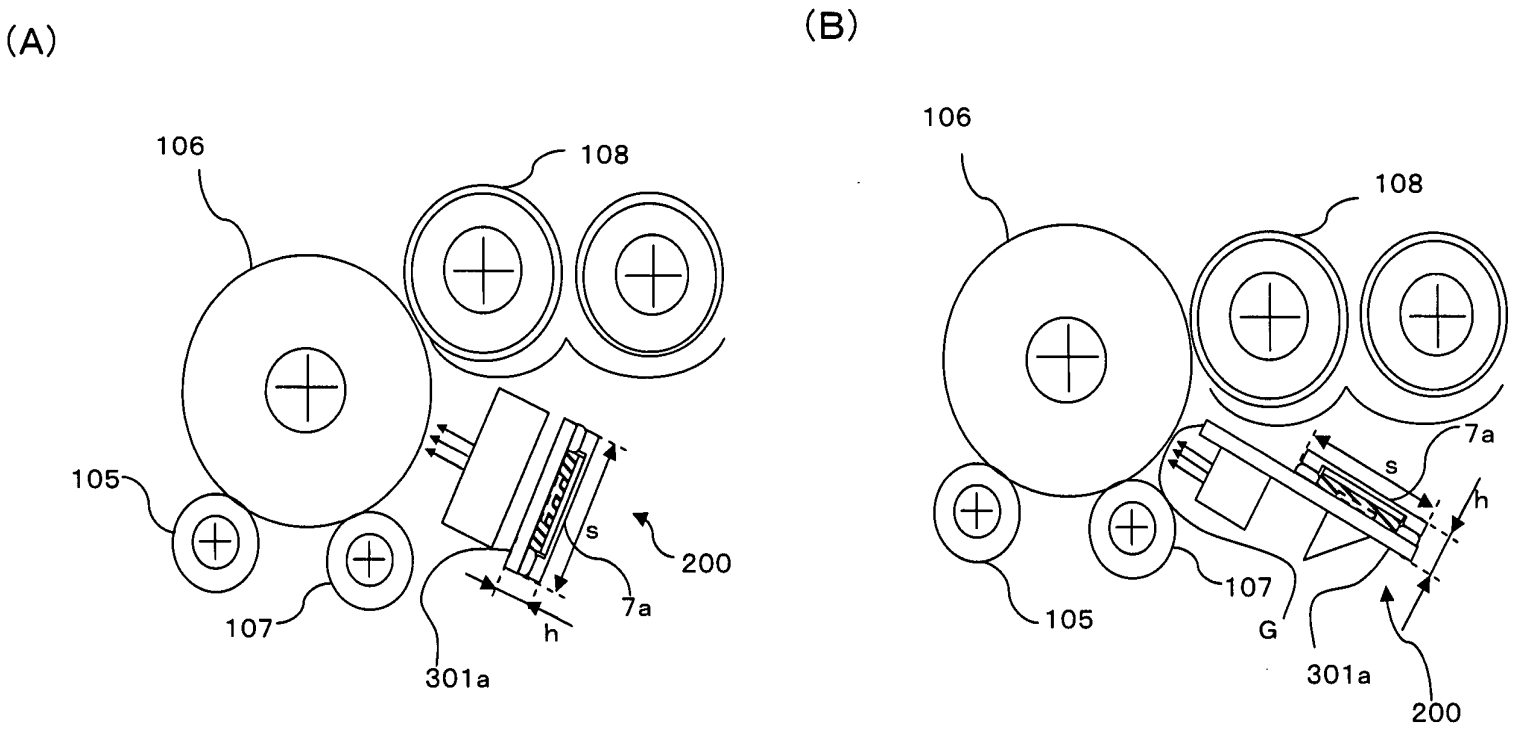


FIG. 5

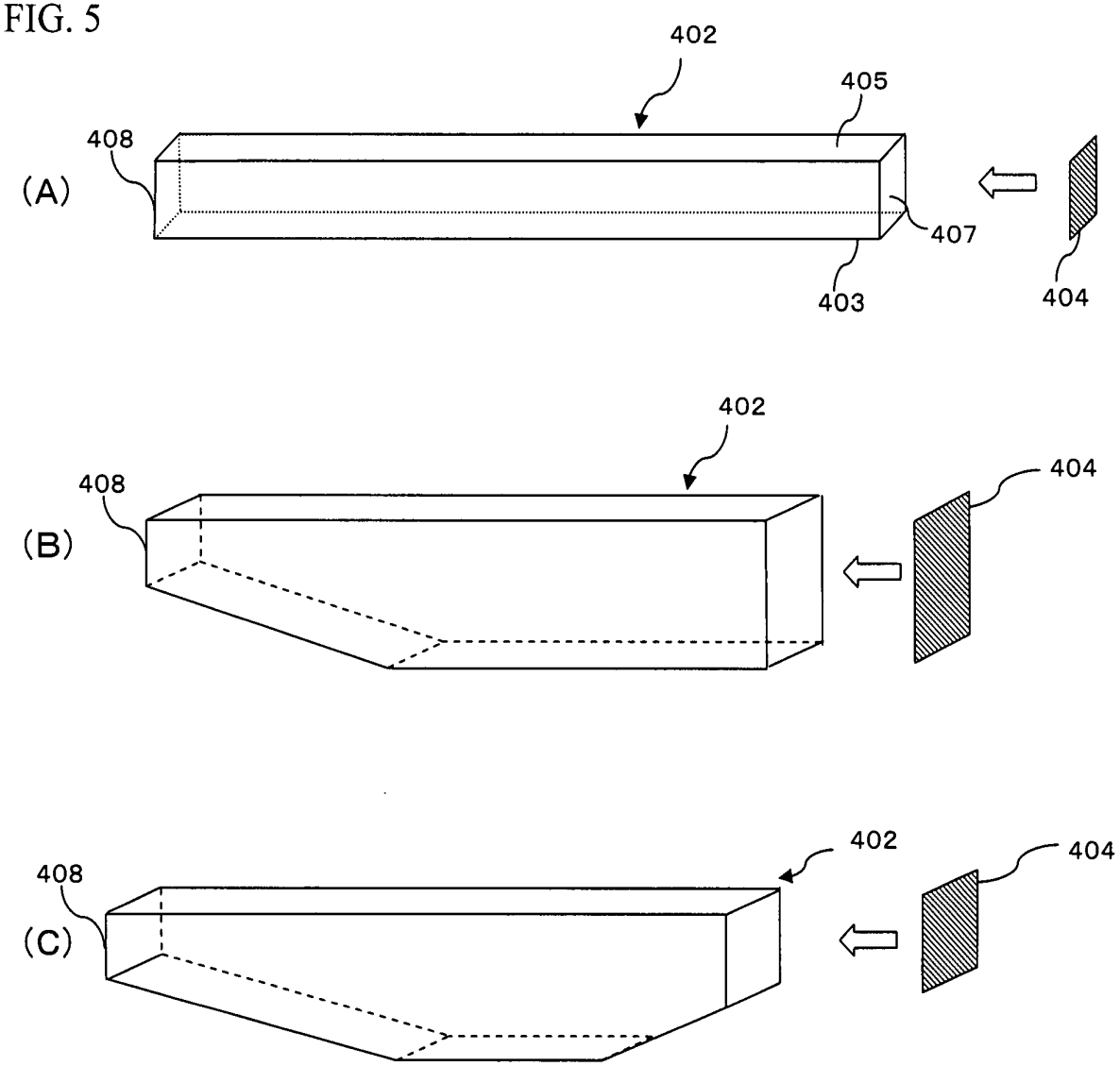


FIG. 6

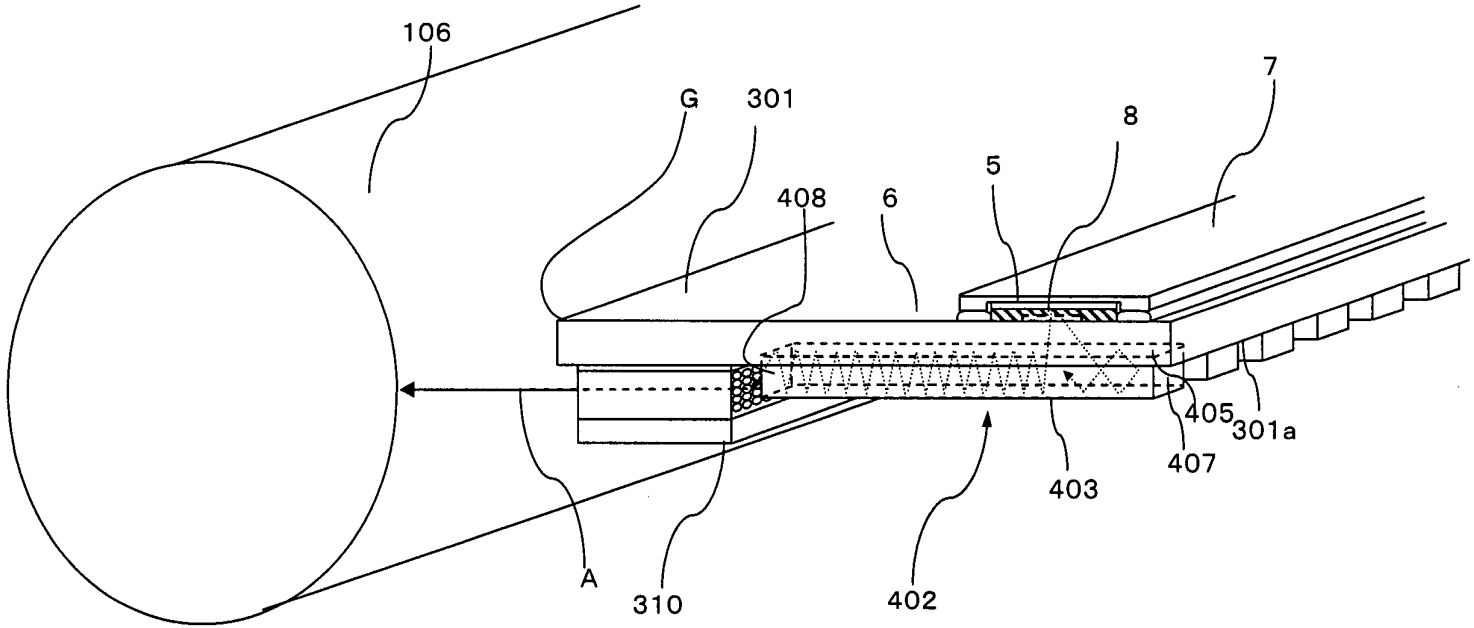


FIG. 7

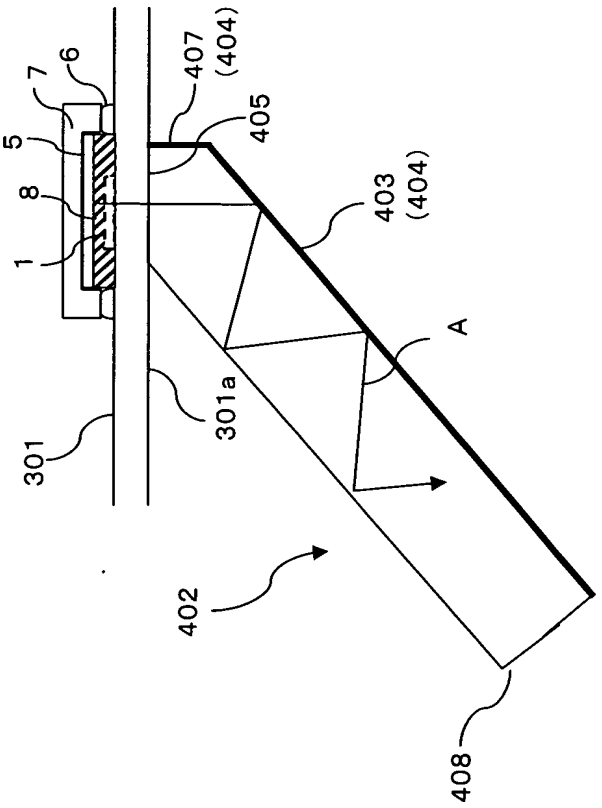


FIG. 8

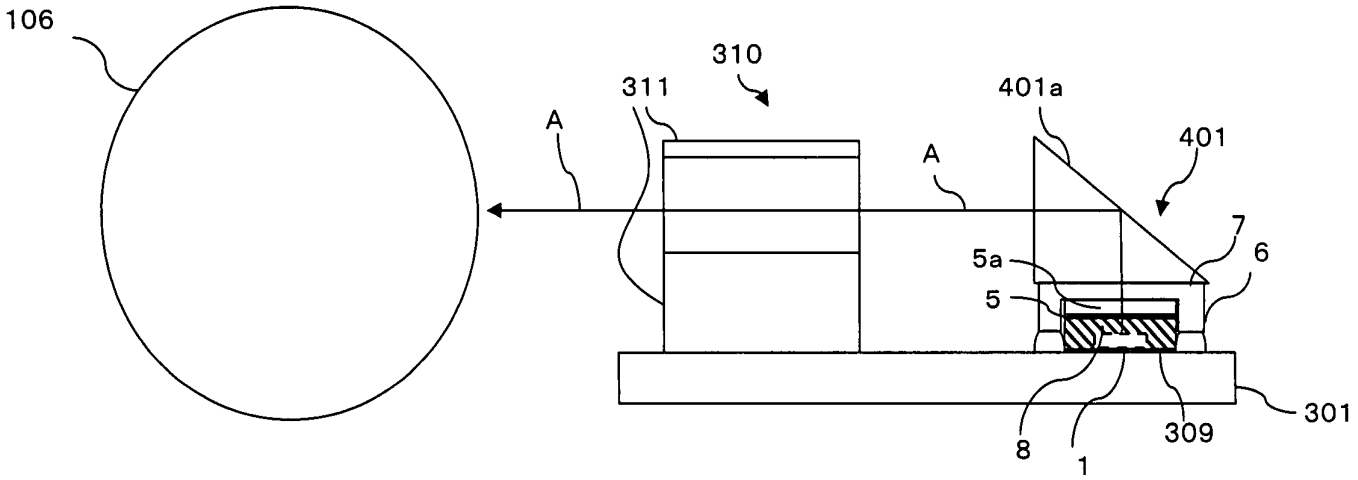
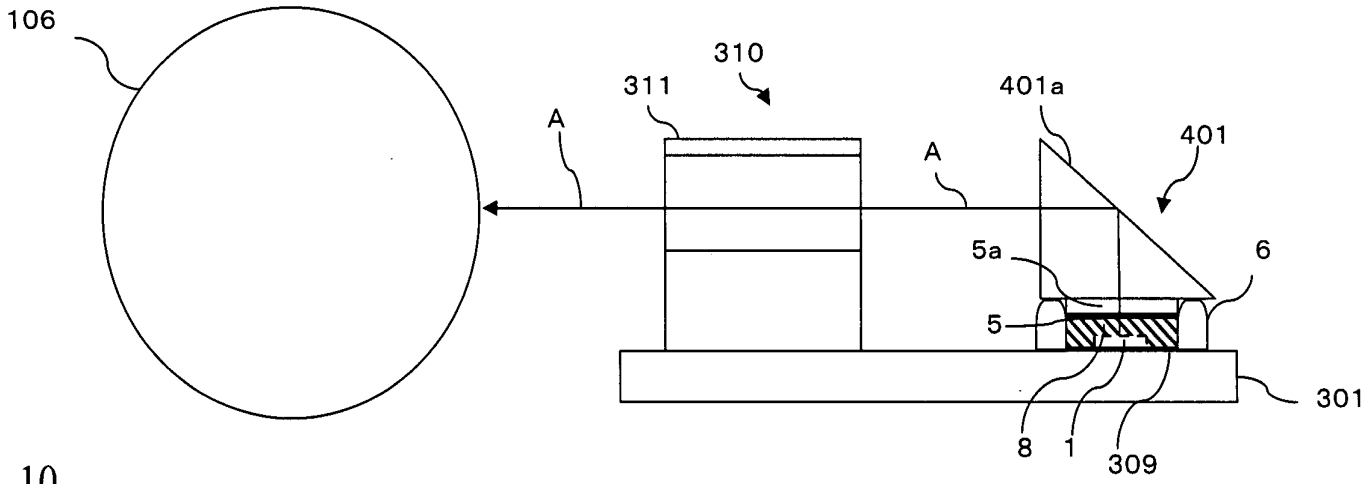


FIG. 9


106
310
311
401a
A
A
401
5a
6
5
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8
1
309

FIG. 10

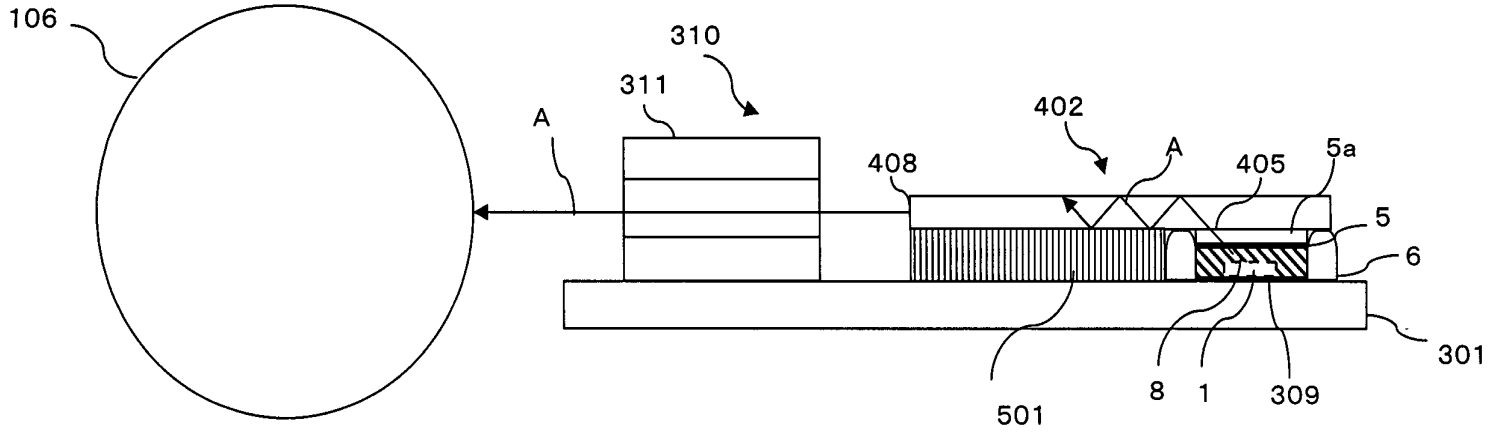
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FIG. 11

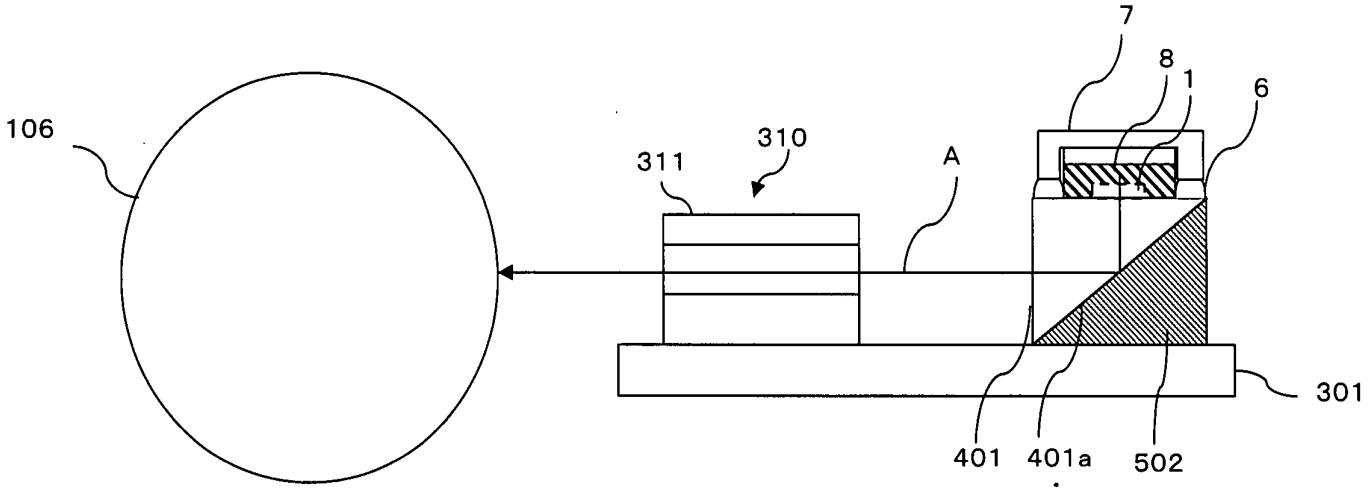
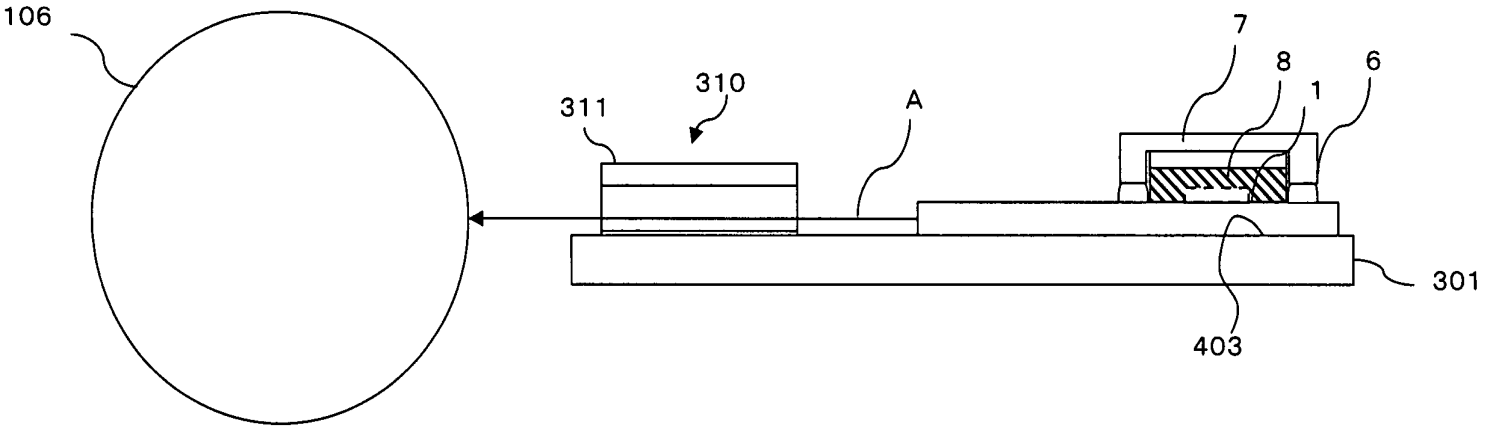


FIG. 12



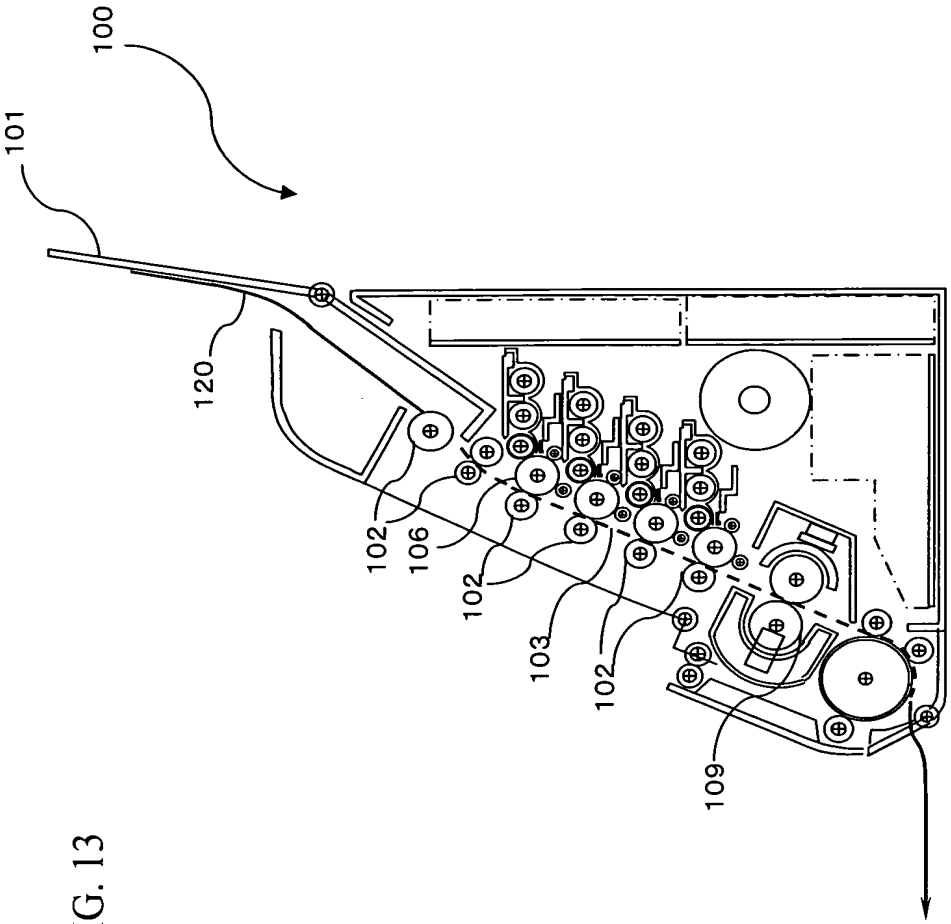
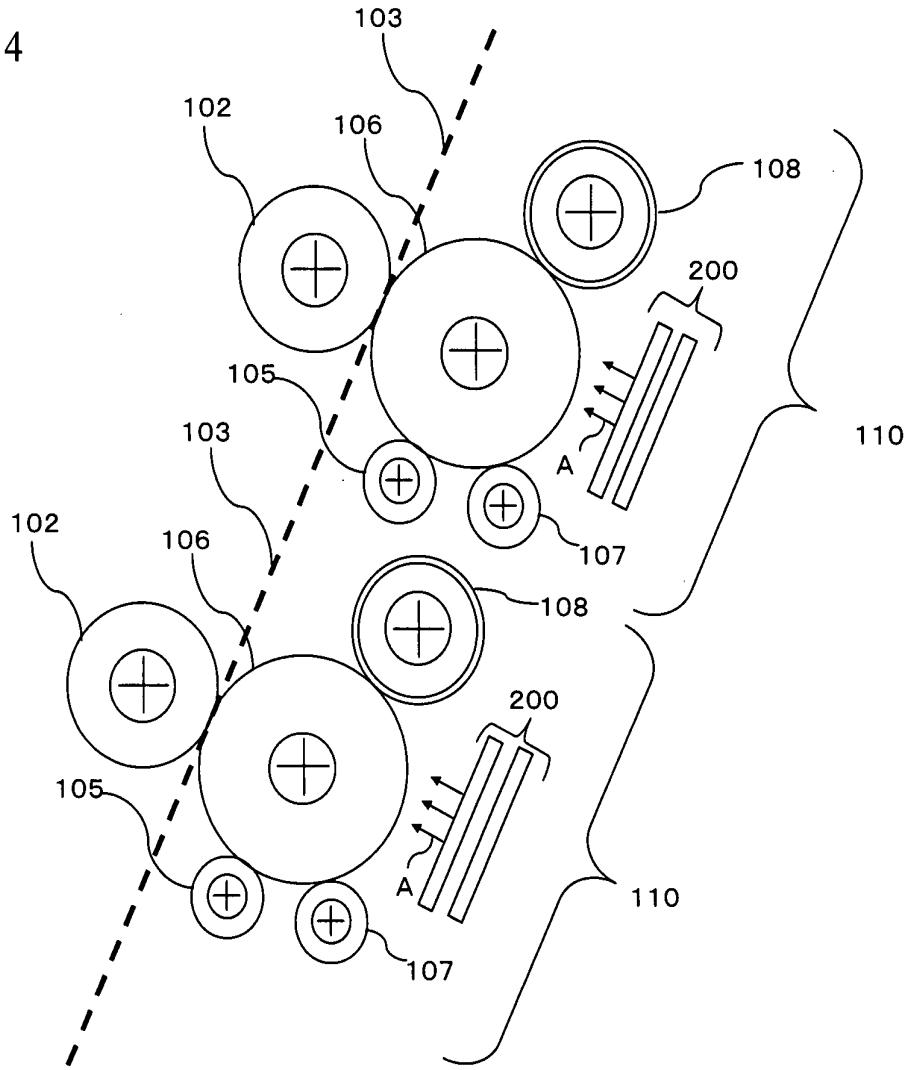


FIG. 13

FIG. 14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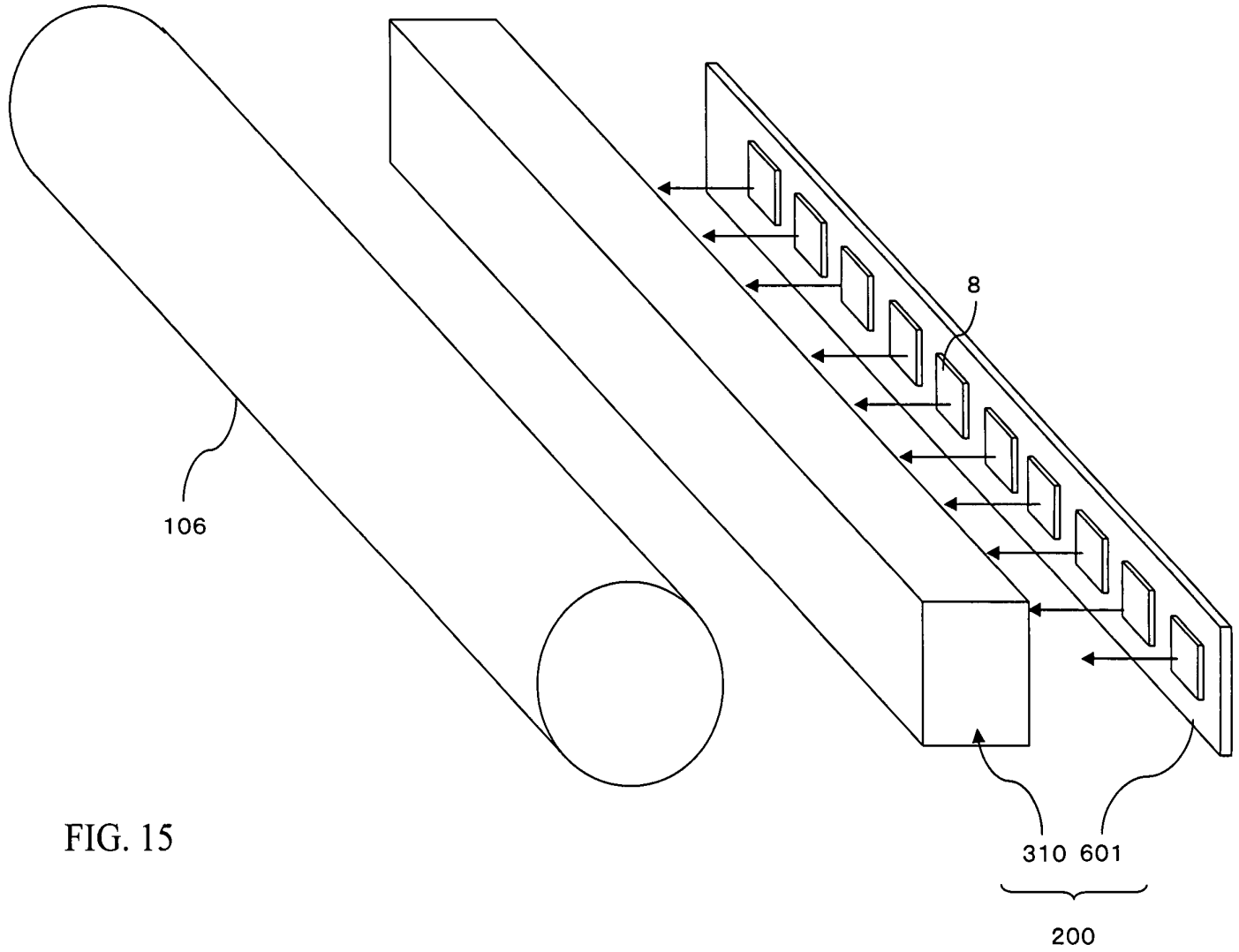

FIG. 15